SONOELECTRONICS PROGRAM
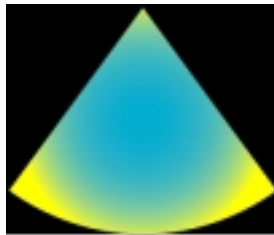# LOW-POWER, HIGH-RESOLUTION 3D SONAR IMAGING SYSTEM

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SONOELECTRONICS PROGRAM

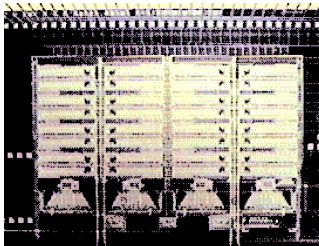# LOW-POWER, HIGH-RESOLUTION 3D SONAR IMAGING SYSTEM

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OBJECTIVE

- DEVELOP HIGH-RESOLUTION, LOW-POWER LOW-COST, HAND-HELD SONAR IMAGER BASED ON SPARSE ARRAY CONCEPT

- 128 X 128 PIXEL IMAGE @ 400 (2D) FRAMES/s or 4 (3D rendered) FRAMES/s WITH 1 cm CROSS-RANGE & DOWN-RANGE RESOLUTION

- FULLY-INTEGRATED ELECTRONIC BEAMFORMING

APPROACH

- STATE-OF-THE-ART 2D SPARSE ARRAY (TETRAD)

- BANDWIDTH SELECTION IMPROVING SIGNAL TO SIDELOBE RATIO (NUWC)

- LOW-POWER, HIGH-THROUGHPUT CHARGE-DOMAIN ELECTRONIC BEAMSTEERING/BEAMFORMING (TERATECH)

- ICs MANUFACTURABLE IN CMOS FOUNDRY (TERATECH)

ACHIEVEMENTS

- WIDEBAND SPARSE ARRAY SIMULATION with 40 dB SIGNAL-TO-SIDELOBE RATIO

- PROCESSING/COMPONENT DEVELOPMENT 32-CHANNEL 1D TIME-DOMAIN BEAMFORMING 5 BILLION OPs/s @ 1 WATT

- 1D-SPARSE-ARRAY DELIVERED TO NUWC; DATA OBTAINED IN NEWPORT, RI TEST FACILITY

MILESTONES

- SPARSE ARRAY WITH 32 ACTIVE ELEMENTS (7/99)

- SPARSE ARRAY WITH 128 ACTIVE ELEMENTS

- 128-ELEMENT SUBARRAY MODULE DEMO

- 20X20 cm 2D SPARSE ARRAY WITH ELECTRONIC BEAMFORMING

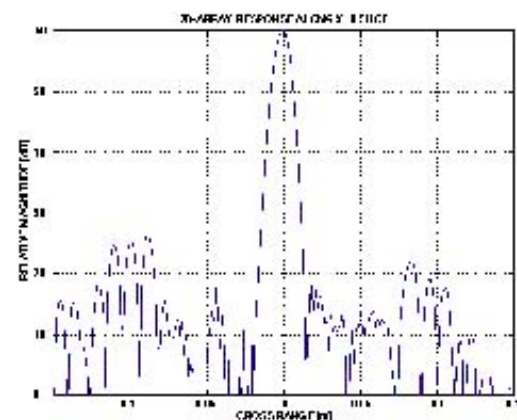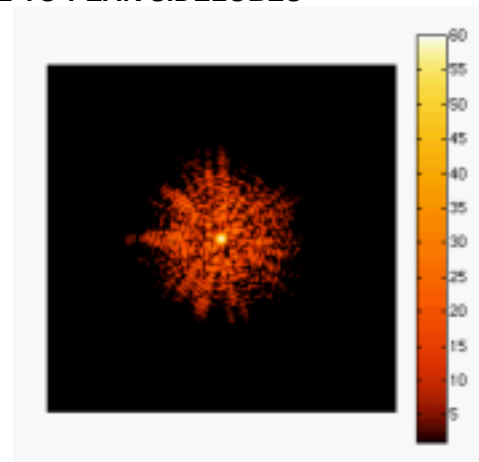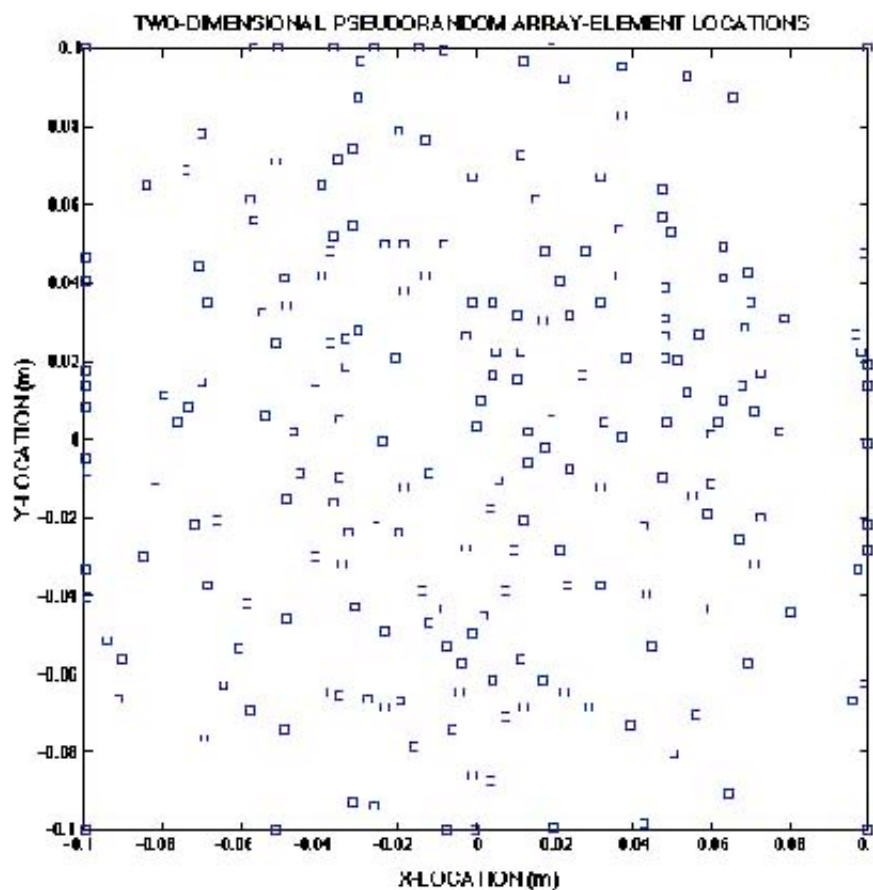- 20X20 cm 2D SPARSE ARRAY WITH ELECTRONICS SYSTEM DEMONSTRATION

2D SPARSE-ARRAY OPTIMIZATION

- **WIDEBAND SPARSE-ARRAY OPTIMIZATION**
  - WIDE BANDWIDTH, RANDOM PLACEMENT FOR IMPROVED BEAM PROFILE
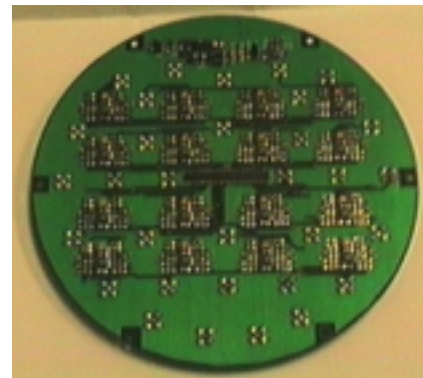 - 40 dB SIGNAL-TO-AVERAGE SIDELOBE RATIO AND 30 dB SIGNAL-TO-PEAK SIDELOBES

TWO-DIMENSIONAL PSEUDORANDOM ARRAY-ELEMENT LOCATIONS

1D SPARSE-ARRAY SONAR SYSTEM

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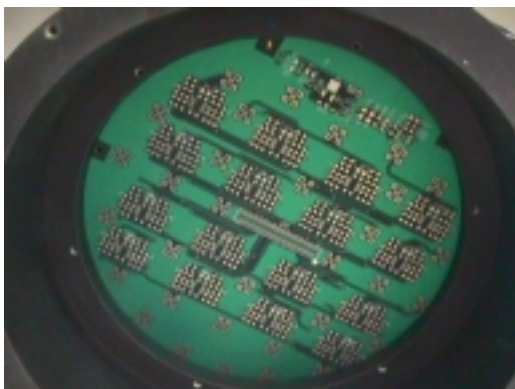- **WIDEBAND 1D SPARSE-ARRAY**
  - ELEMENT-PLACEMENT OPTIMIZATION ALGORITHM YIELDS >20 dB SIGNAL-TO-PEAK SIDELOBES
  - PROVIDES VERIFICATION OF WIDE BANDWIDTH, 2D-ARRAY

- **1D SPARSE-ARRAY AND ELECTRONICS EVAL SYSTEM**
  - 32-ELEMENT, 20 cm ONE-DIMENSIONAL ARRAY MATED TO CUSTOM PC BOARD
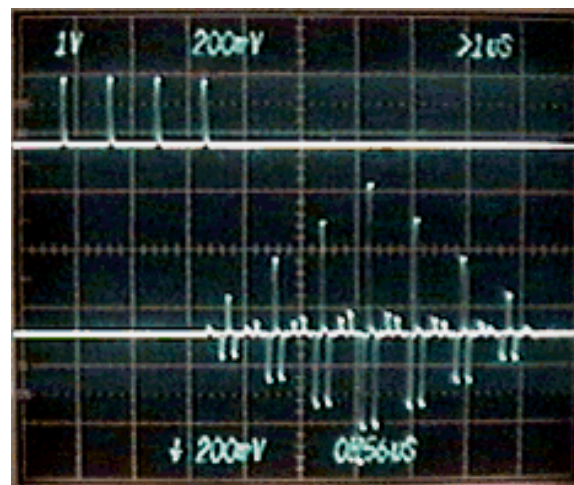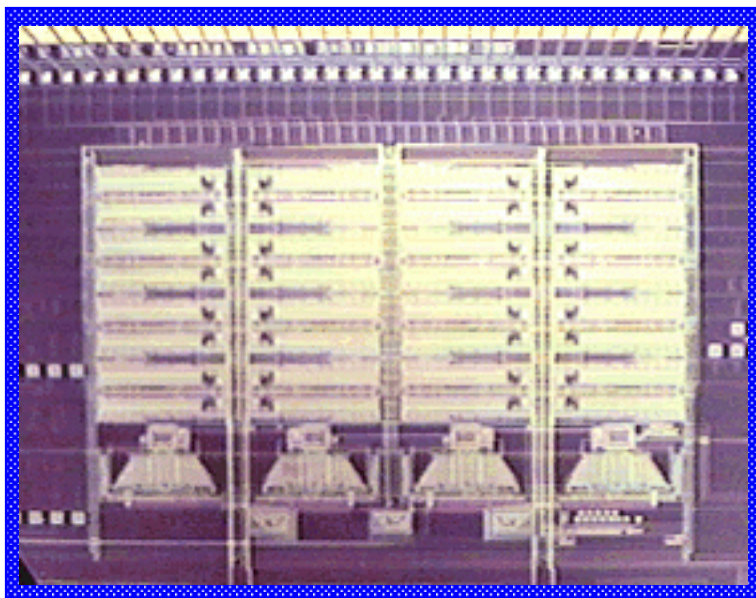 - 32-PREAMPLIFIER OUTPUTS CONNECTED TO DRY-END DATA ACQUISITION PLATFORM - NUWC

32-CHANNEL, CCD/CMOS ELECTRONIC BEAMFORMER

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FULLY-PROGRAMMABLE, APODIZED, DELAY LINES WITH ON-CHIP BANDPASS FILTER

5.5 BILLION OPs/s @ 1 WATT POWER DISSIPATION
CHARGE-TRANSFER INEFFICIENCY < 1.39E-4
AT 20 MHz CLOCK RATE